Significant figures

There are 2 kinds of numbers:

Exact: the amount of money in your account. Known with certainty. Anything *COUNTED*

Approximate: weight, height—anything **MEASURED**. No measurement is perfect.

Recall

A. Exact numbers are obtained by
    1. using a measuring tool
    2. counting
    3. definition

B. Measured numbers are obtained by
    1. using a measuring tool
    2. counting
    3. definition

Practice

Classify each of the following as an exact or a measured number.

1 yard = 3 feet

The diameter of a red blood cell is 6×10^{-4} cm.

There are 6 hats on the shelf.

Gold melts at 1064°C.

When to use Sig Figs

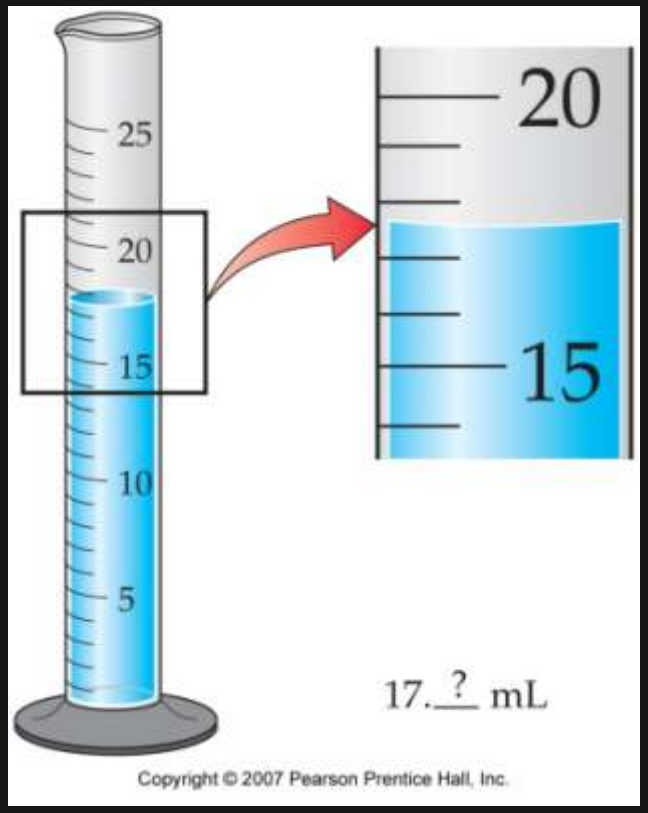
When a measurement is recorded only those digits that are **dependable** are written down.

Every experimental measurement has a degree of uncertainty.

The volume, V, at right is certain in the 10's place, 10mL<V<20mL

The 1's digit is also certain, 17mL<V<18mL

A best guess is needed for the tenths place.



Another Example

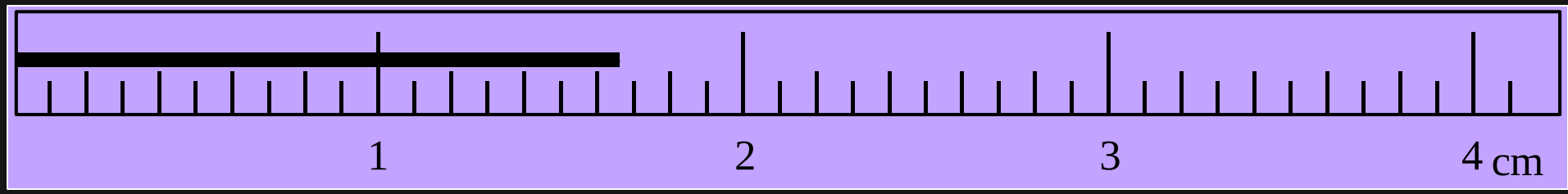
We can see the markings between 1.6-1.7cm

We can't see the markings between the .6-.7

We must guess between .6 & .7

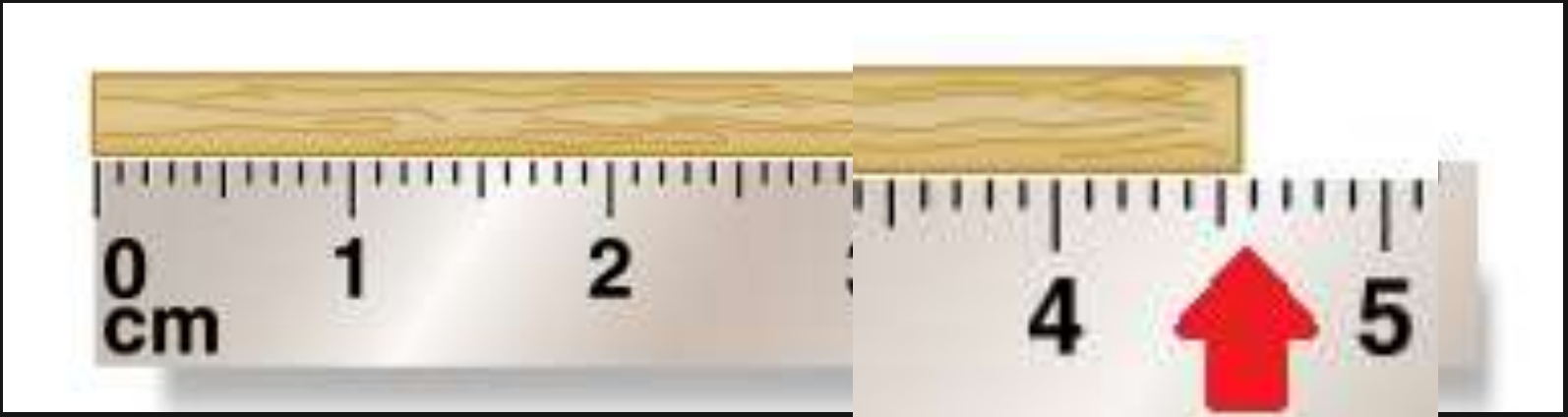
We record 1.67 cm as our measurement

The last digit an 7 was our guess...stop there



Your Turn

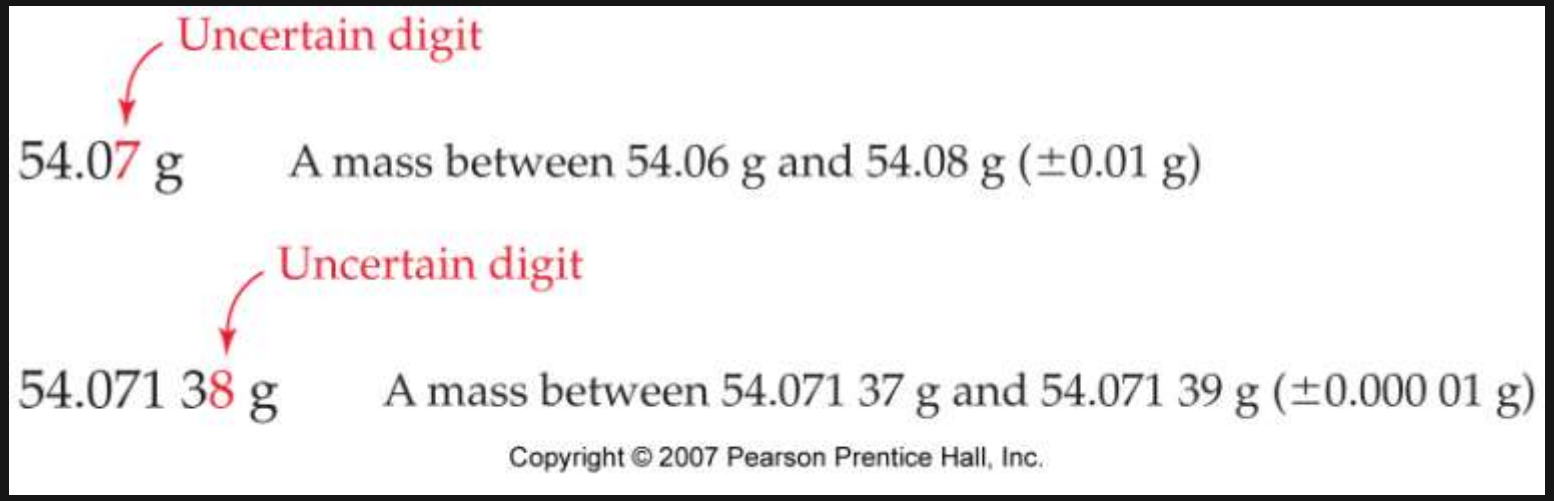
Measured Numbers have error…you have to make that Guess!



What is the length of the wooden stick?

1) 4.5 cm
2) 4.54 cm
3) 4.547 cm

Recorded Numbers



All but one of the significant figures are known with certainty. The last sig. fig. is only to the best possible estimate.

To indicate the precision of a measurement, the value recorded should use all the digits known with certainty.

The Rules

RULE 1. Zeros in the middle of a number are like any other digit; they are always significant.

Ex. 45.081 g has five significant figures.

RULE 2. Zeros at the beginning of a number are *not* significant; they act only to locate the decimal point.

Ex. 0.0537 cm has three significant figures, and 0.069 01 mL has? **4**

The Rules cont.

RULE 3. Zeros at the end of a number and *after* the decimal point are significant. It is assumed that these zeros would not be shown unless they were significant.

Ex. 527.700 m has six significant figures.

If the value were known to only four significant figures, we would write 527.7 m.

The Rules cont.

RULE 4. Zeros at the end of a number and *before* an implied decimal point may or may not be significant. We cannot tell whether they are part of the measurement or whether they act only to locate the unwritten but implied decimal point.

Ex. 280 000km has 2 sig. figs.

How Many Sig Figs?

a. 45.8736

b. 0.000239

c. 0.00023900

d. 48000.

e. 48000

f. 3.982×10^6

g. 1.00040

Scientific Notation

When ever you are unsure – convert to scientific notation

$$215. = 2.15 \times 10^2$$

Decimal point is moved two places to the left, so exponent is 2.

$$3.7962 \times 10^4 = 37{,}962$$

Positive exponent of 4, so decimal point is moved to the right four places.

$$1.56 \times 10^{-8} = 0.000\,000\,015\,6$$

Negative exponent of –8, so decimal point is moved to the left eight places.

Adding and Subtracting

Rule: When adding or subtracting measured numbers, the answer can have no more places after the decimal than the **LEAST** of the measured numbers.

Practice

5.45cm + 2.3cm = 7.75cm,
Round off to = 7.8cm

You try:
7.432cm + 2cm =
9.432 round to → 9cm

Multiplications and Division

Rule: When multiplying or dividing, the result can have no more significant figures than the **least** reliable measurement.

Practice

56.78 cm x 2.45cm = 139.111 cm^2

Round to → 139cm^2

75.8cm x 9.6cm = ?

Bell Work
28-Aug-2015 Pre - AP

A man in a restaurant asked a waiter for a juice glass, a dinner plate, water, a match, and a lemon wedge. The man poured water on the plate to cover it.

"If you can get the water on the plate into this glass without touching or moving this plate, I will give you $100," the man said. "You can use the match and lemon to do this."

A few minutes later, the waiter walked away with $100 in his pocket. ***How did the waiter get the water into the glass?***

Objective

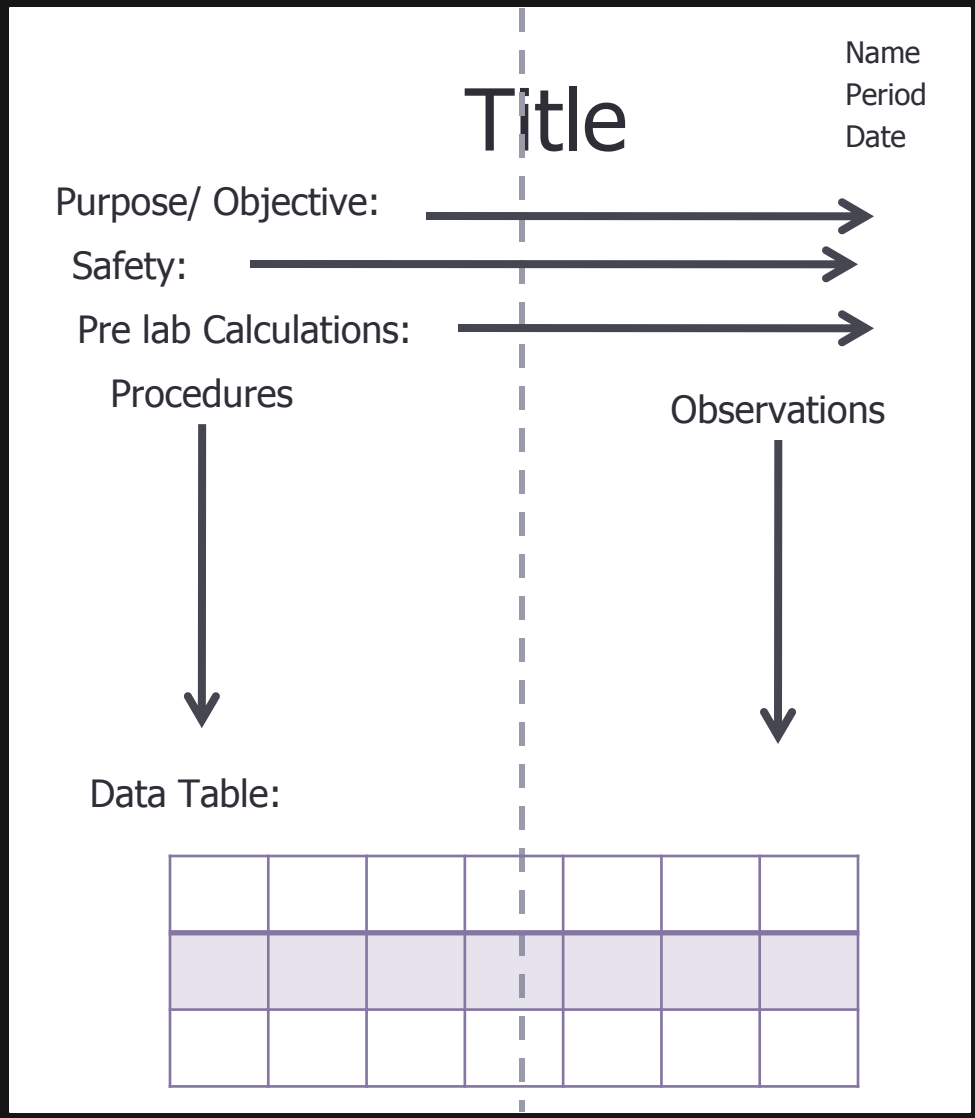
You will be able to determine the density of a metal after finding its mass and volume.

You will learn a fast method for finding volume.

Pre Lab

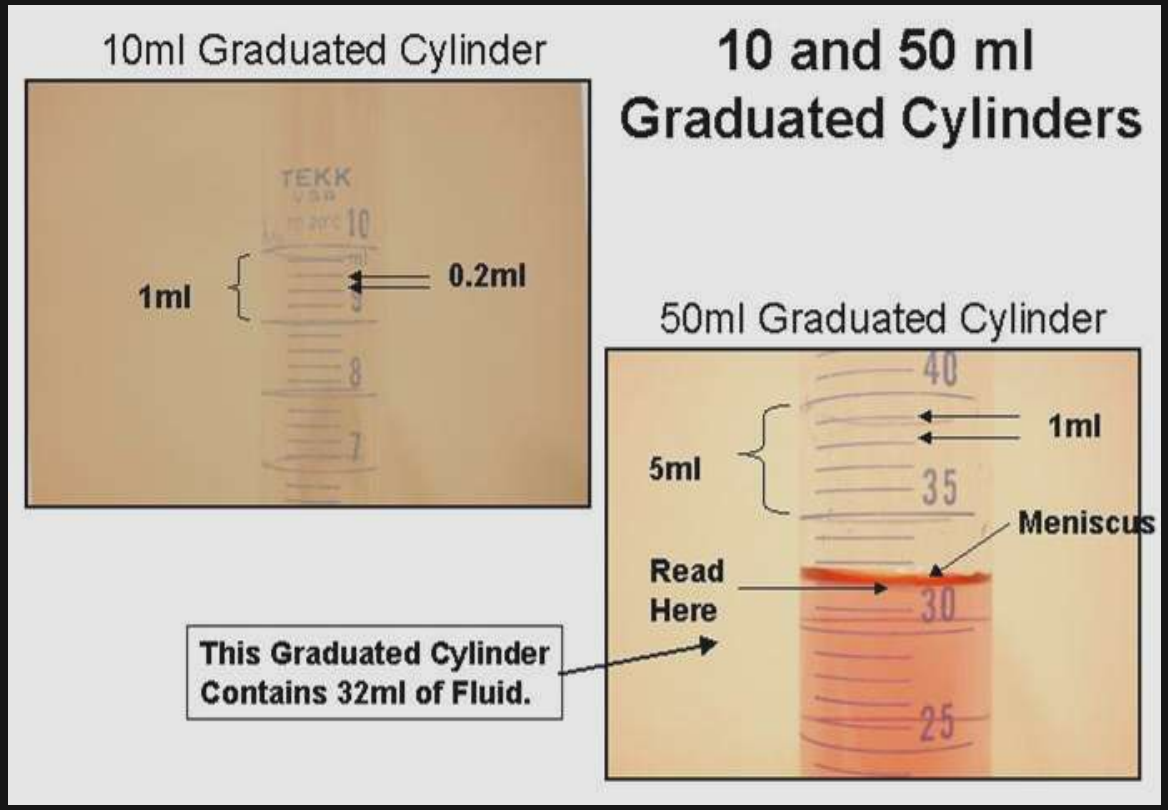
Use as many piece of paper as you need, try not to write on both side.

Analysis and conclusions should be recorded at the end of the pre lab after the lab



Reading a Graduated Cylinder

What do you think is the volume of the solution in your graduated cylinder?



Density Lab

There are eight (8) different metals, A-H, you will work each and rotate through the lab

Each metal type needs a minimum of three (3) different samplings of volume and mass.

Dry metals before weighing, all sphere metals use weigh boats

Density Lab

Safety: Do Not touch the lead, Pb, with your fingers or hand. No Toces El Plomo

When using the Pb and "G" use 15 balls at a time.

So 15, 30, 45, ____ etc. when measuring

Follow directions!

When finished, record data on board for class to copy down for graphs.

Before you leave…

What laboratory tool could you use to find the volume of a metal nut?

How would you carry out the measurement?

What should you be sure to do to insure the volume is measured correctly?

When finished record data on board for class to copy down for graphs.
Email graph to: william.golden@fwusd.org
Subject: P.X.LastName.FirstName.Density

Bell work
31-Aug-2015

If a clay brick measures 20.0cm x 10.0cm x 10cm, what is the volume of the brick, in mm^3?

scrapbookoftruth.net

EQ: Suppose there are three parts to learning in school; student, teacher, and content/material. What is your role as a student including responsibilities and expectations

Agenda:

Finish density lab and record all data as a class.

Recap

What did we do in the lab Friday day?

What two (2) measurements did we make?

Intensive property: Independent of the quantity or amount (Melting point, density, Molar Mass, etc.)

Extensive property: Depends on the amount. (Mass, volume, temperature, measurements)

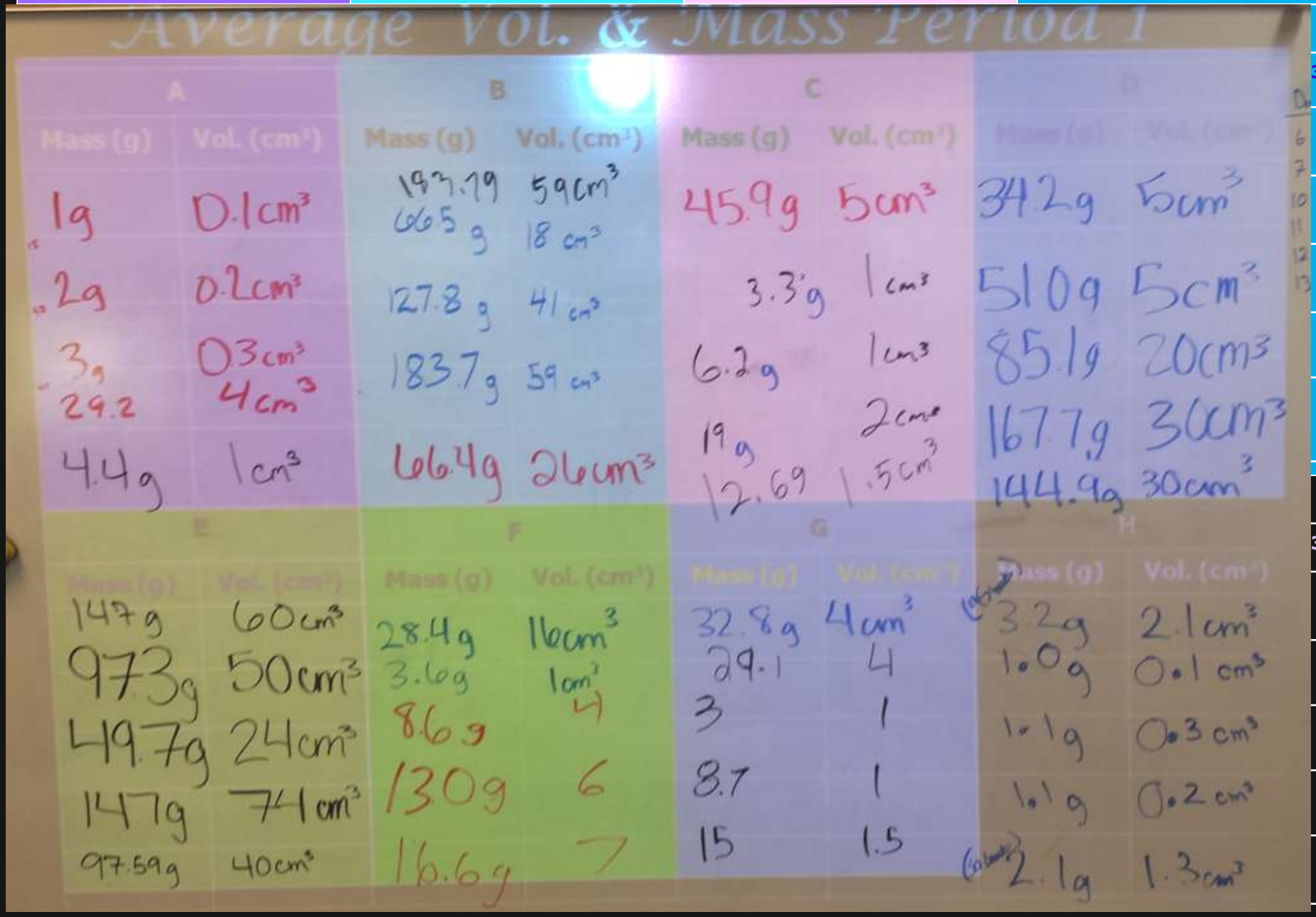
Actual Density Values for percent Error

1. Person from each group:

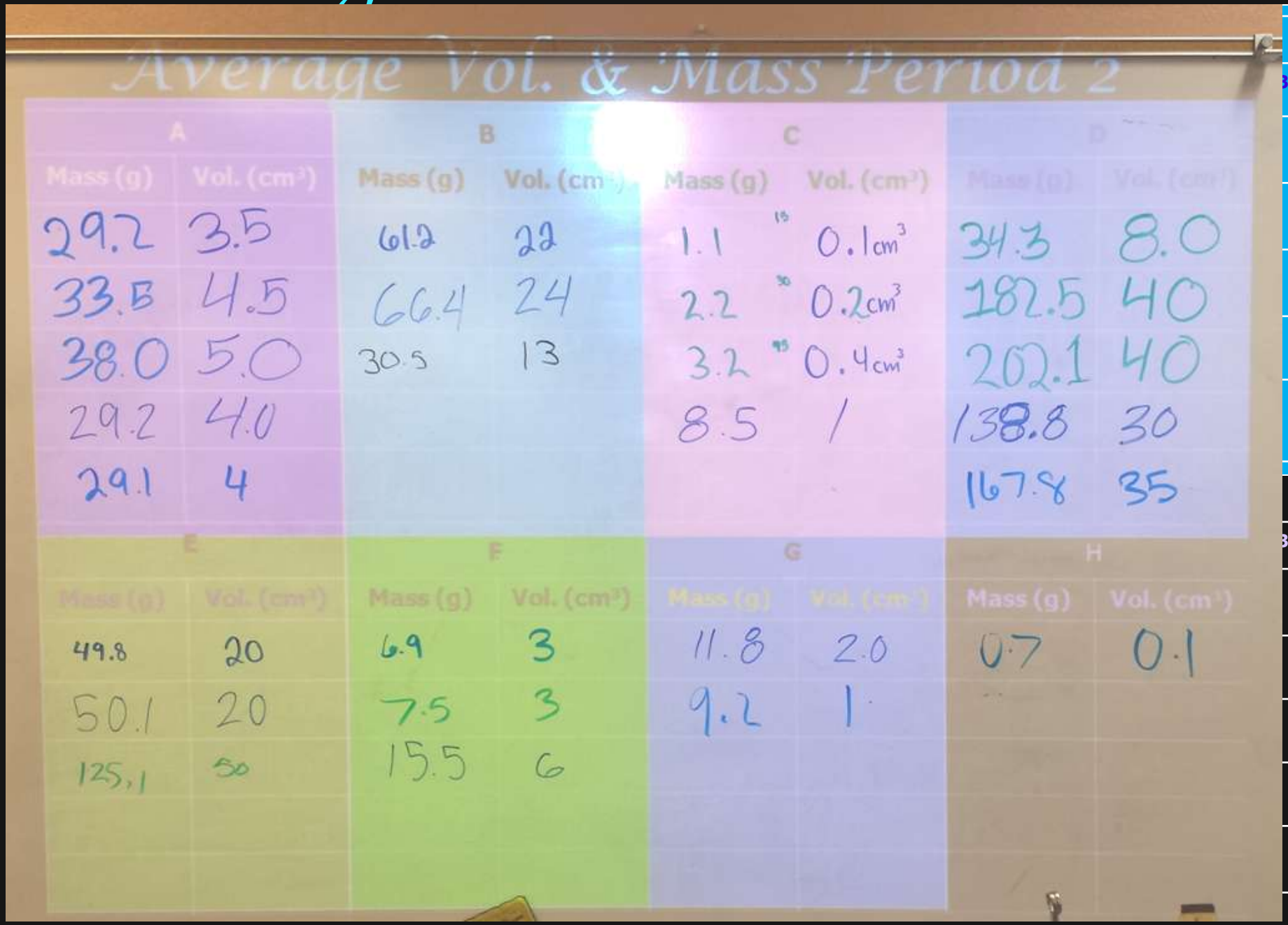
Please come up to board and enter any *one* of your values you measured for each sample

2. Take a picture or look up data on class website in power point section

Average Vol. & Mass Period 1



Average Vol. & Mass Period 2



Average Vol. & Mass Period 3

A		B		C		D	
Mass (g)	Vol. (cm³)	Mass (g)	Vol. (cm³)	Mass (g)	Vol. (cm³)	Mass (g)	Vol. (cm³)
29.2	7	66.5	24	2.7	1	144.6	10
33.5	5	66.4	24	7.4	2	26.1	13
29.2	4	30.4	12	5.5	1	50	20
29.2	3			12.6	2	19.1	4
29.2	5					167.8	3

E		F		G		H	
Mass (g)	Vol. (cm³)	Mass (g)	Vol. (cm³)	Mass (g)	Vol. (cm³)	Mass (g)	Vol. (cm³)
49.4	20	30.3	14	5.7	1	1	0.2
50.0	11mL	14.1	6	15	1	1.0	0.1
		4.4	1	6.2	2	2.1	0.2
				9.3	3		
				3.1	1		

Bell work
1-Sept-2015

Log on to a computer and go to the class website.

EQ: Suppose there are three parts to learning in school; student, teacher, and content/material. What is your role as a student including responsibilities and expectations

Agenda:

Use data from density lab to develop a series of line graphs on excel which show density as slope

Actual Density Values for percent Error

A:St. Fe 8.05g/cm^3

B: Al 2.7g/cm^3

C: Ni 8.90g/cm^3

D: FeS_2 5.02g/cm^3

E: Granit 2.7 g/cm^3

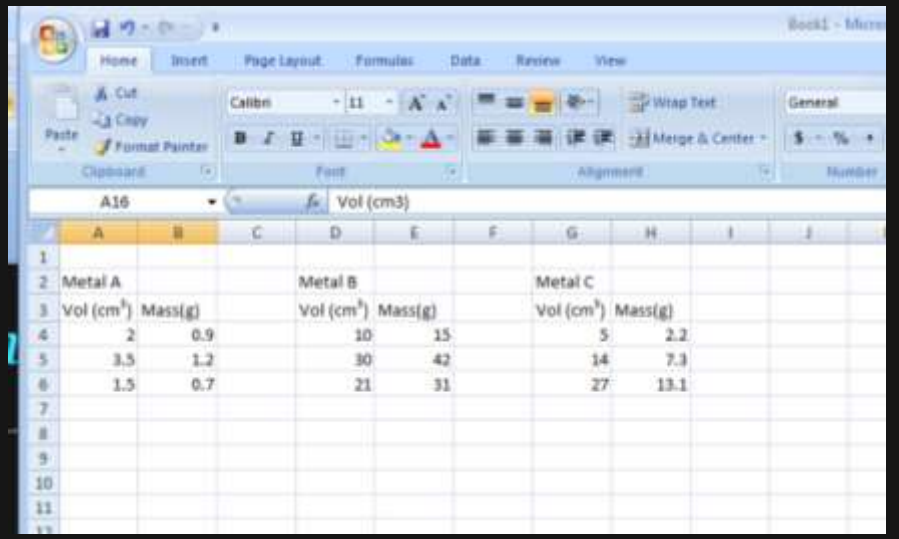
F: Obsidian (SiO_2) 2.6 g/cm^3

G: 8.96g/cm^3

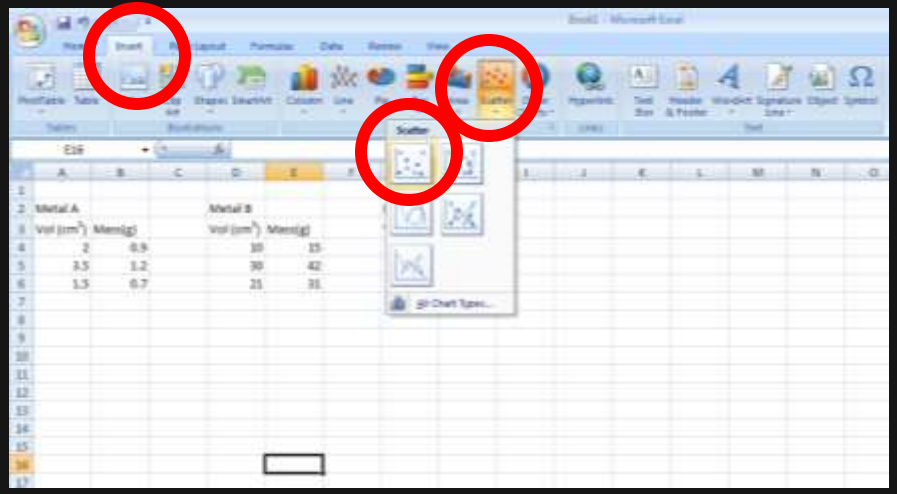
H: Pb 11.34g/cm^3

Making your Graph

1. Enter you data in the spread sheet.

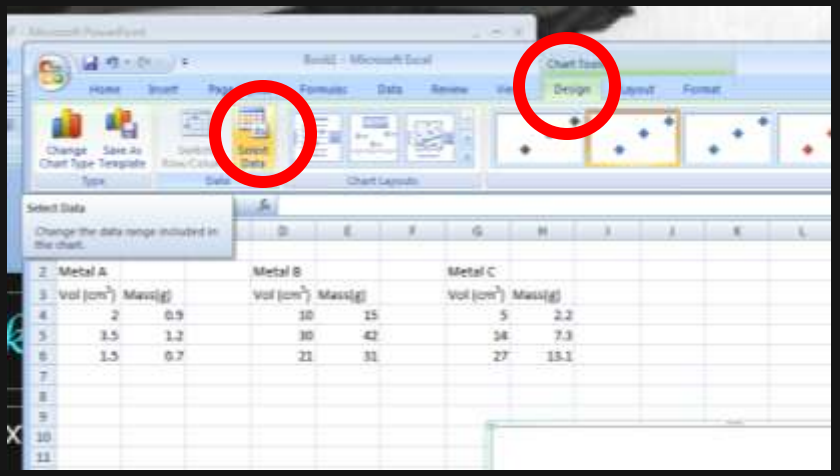


2. Go to the "Insert" tab and select "Scatter"

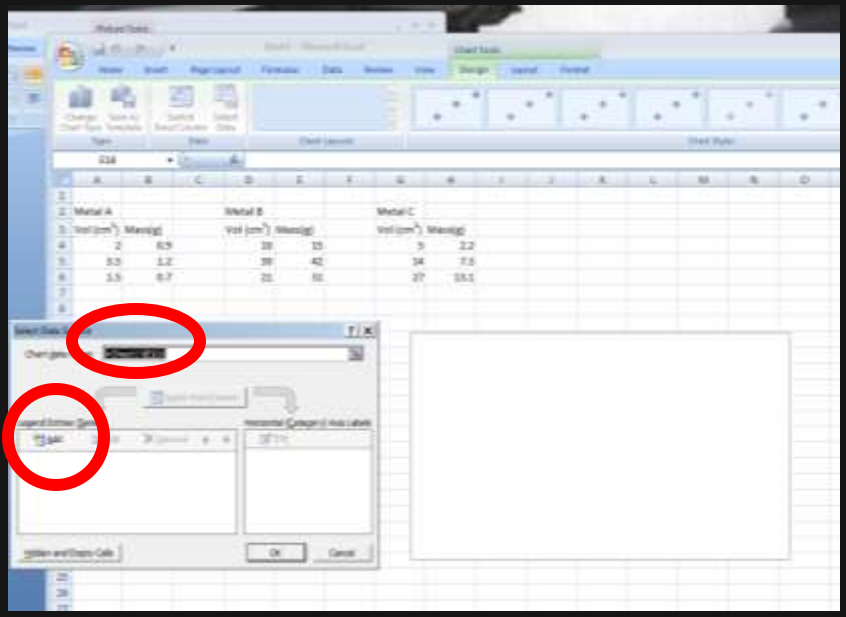


Graph Cont. 2

3. Select "Design" then "Switch Data"

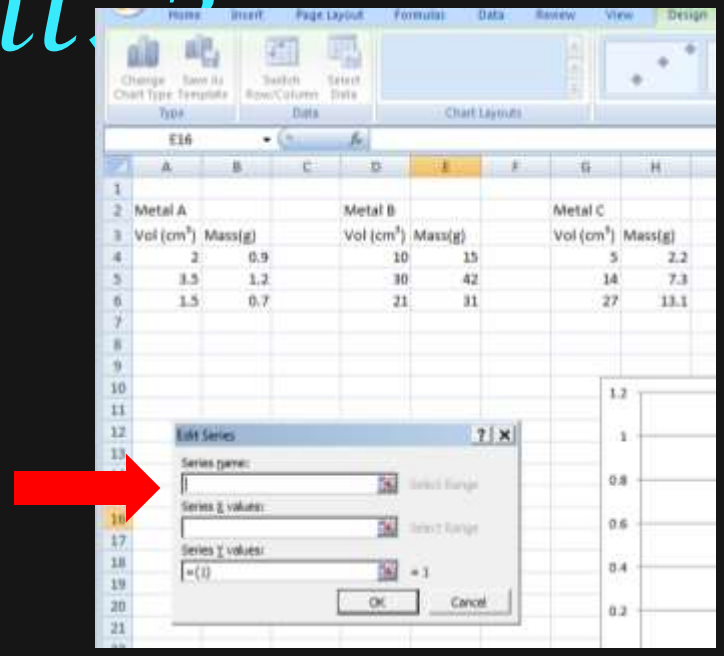


4. Clear Chart Range, and click "Add"

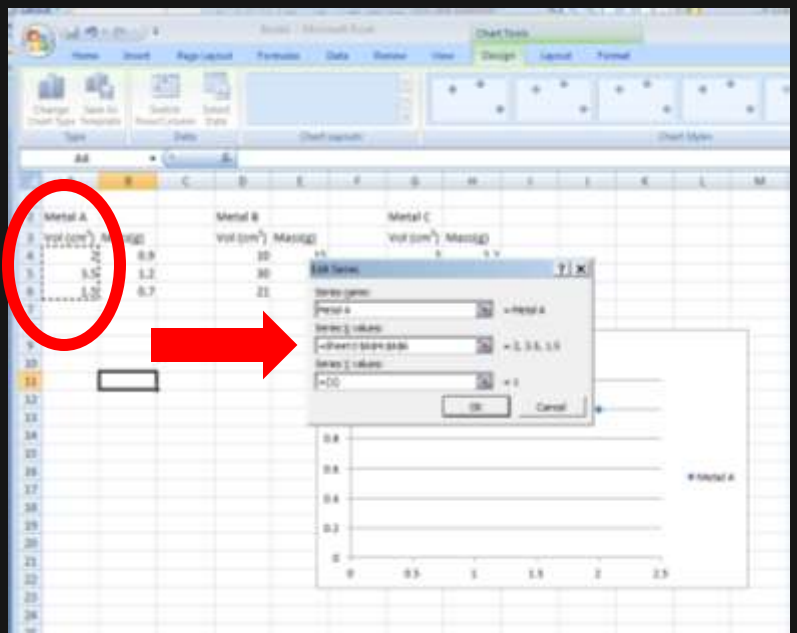


Graph Cont.2

5. Type in Series name

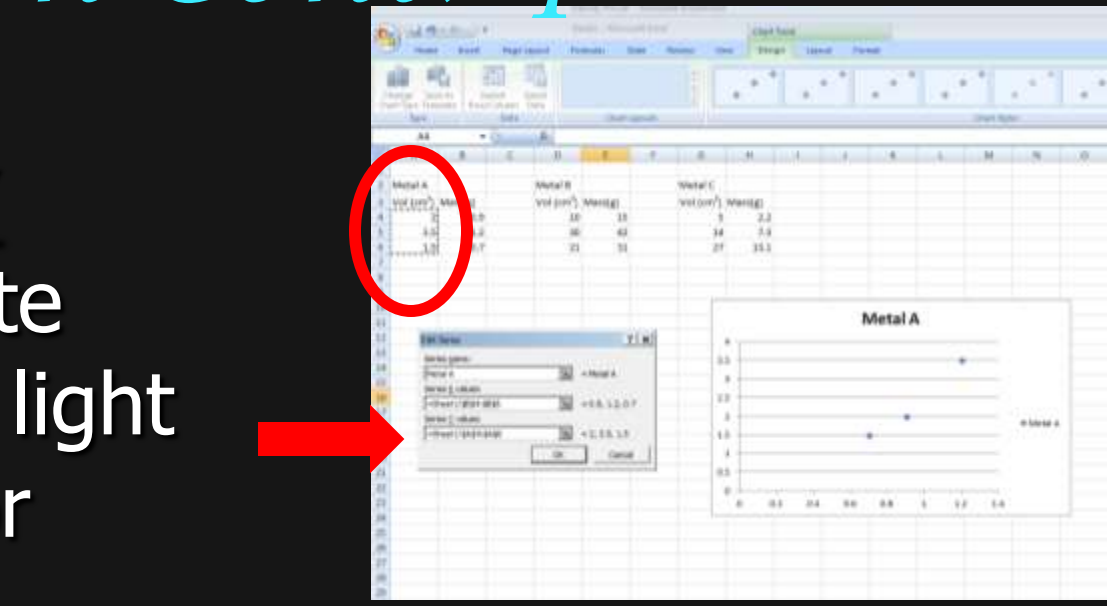


6. Click in "Series X values" and then high light the x-axis data for metal A

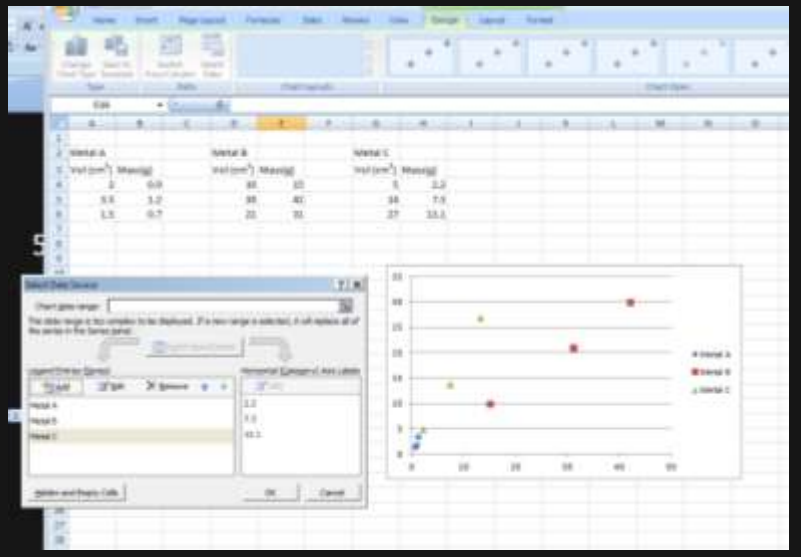


Graph Cont. 4

5. Click in "Series Y values" and, delete "={1}" then high light the y-axis data for metal A

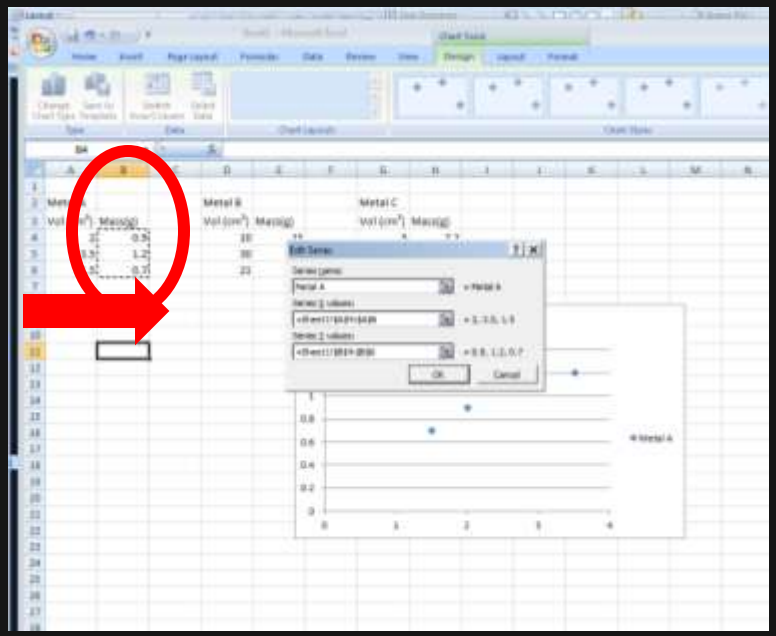


6. Repeat steps 4-6 for each metal



Graph Cont. 5

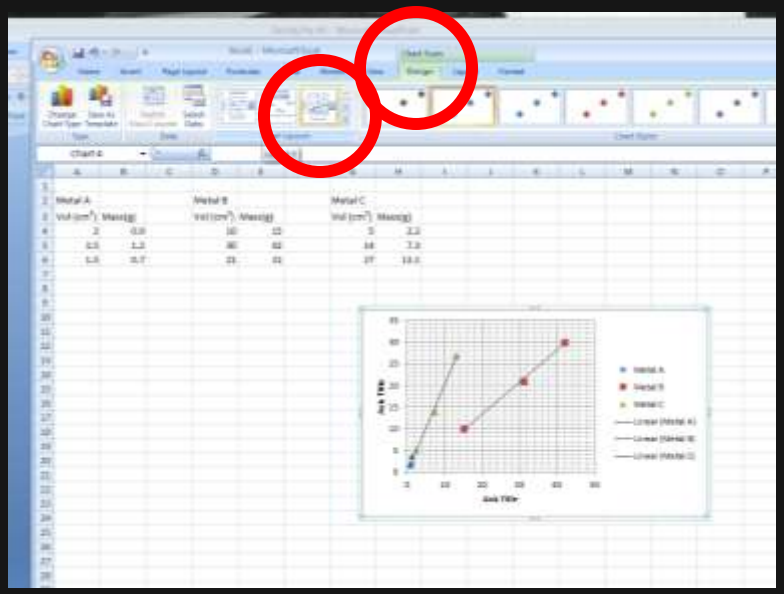
5. Click in "Series Y values" and then high light the y-axis data for metal A



6. Repeat steps 4-6 for each metal

Graph Cont. 6

7. Click on chart then "design", and pick "layout 3"



8. Fill in Axis titles and Chart title, you can calculate slope manually Or using excel "=SLOPE()" formula

Email Your Graphing

Save as: PX.Lastname.Firstname.Density

Email graph to: william.golden@fwusd.org

Subject: PX.Lastname.Firstname.Density

Must be in exact form or No credit.

Each person needs to send graphs

Due by 4:00pm Tuesday 8-Sept-2015

Density

Density compares the mass of an object to its volume

$$D = \frac{\text{mass}}{\text{volume}} = \frac{\text{g}}{\text{ml}} = \frac{\text{g}}{\text{cm}^3}$$

Note: 1 mL=1 cm^3

Bell Work
2-Sept-2015

What is the mass (g and lb) of a bar of lead below with dimensions of base 1 50. mm, base 2 28.mm with a height of 45.mm, a width of 200.mm. The density of lead can be found in the back of your text book.

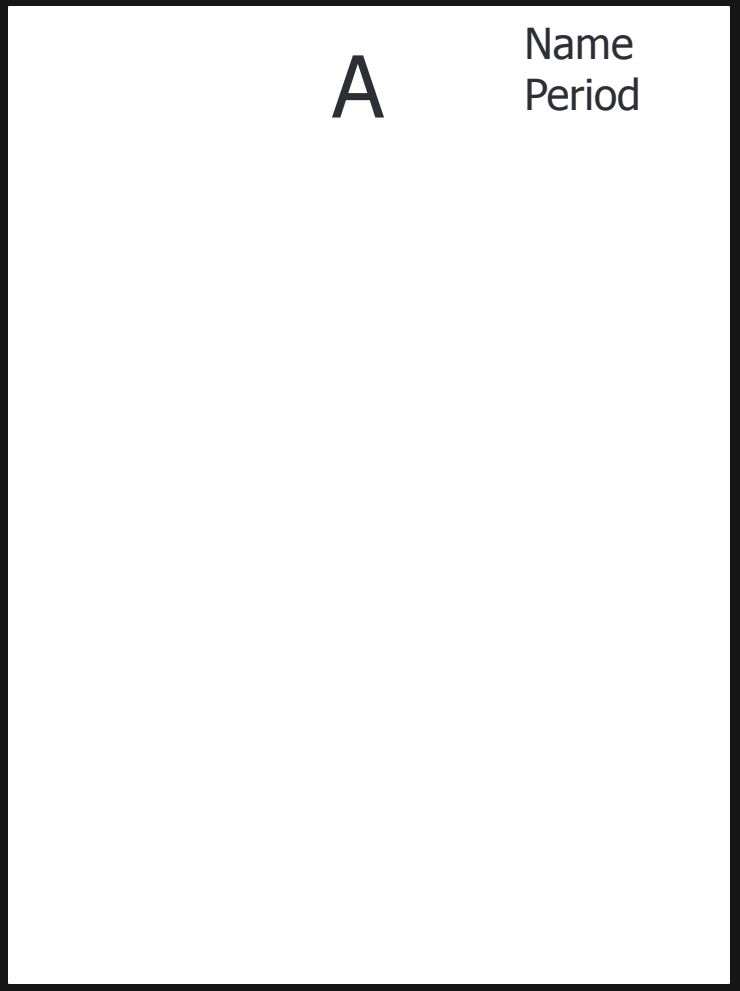
$$Vol_{trap} = \frac{h(b_1 + b_2)}{2} \times w$$

EQ: Suppose there are three parts to learning in school; student, teacher, and content/material. What is your role as a student including responsibilities and expectations

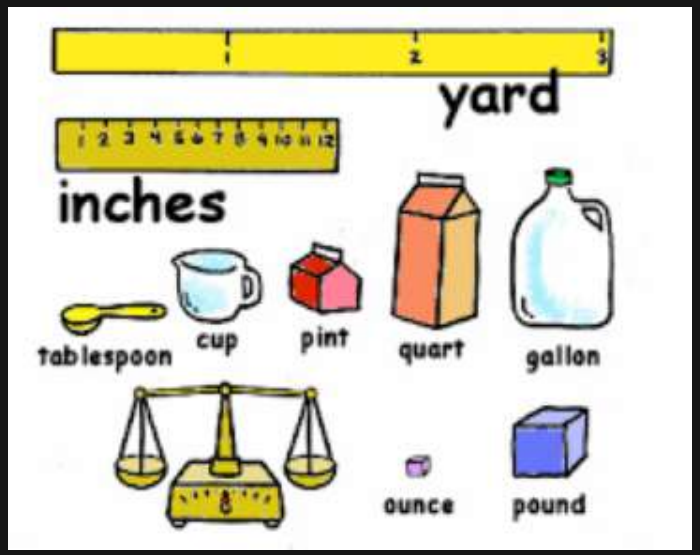
Objective

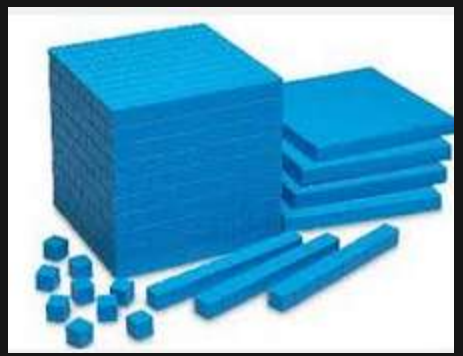
You will complete a short reading and then compose and answer to a promted questions

Writing #1 Page set up



Using information from the article, previous learning, and the lab, write a few paragraphs persuading the US government to use the metric system by describing 3 or more advantages of the metric system over the standard system.





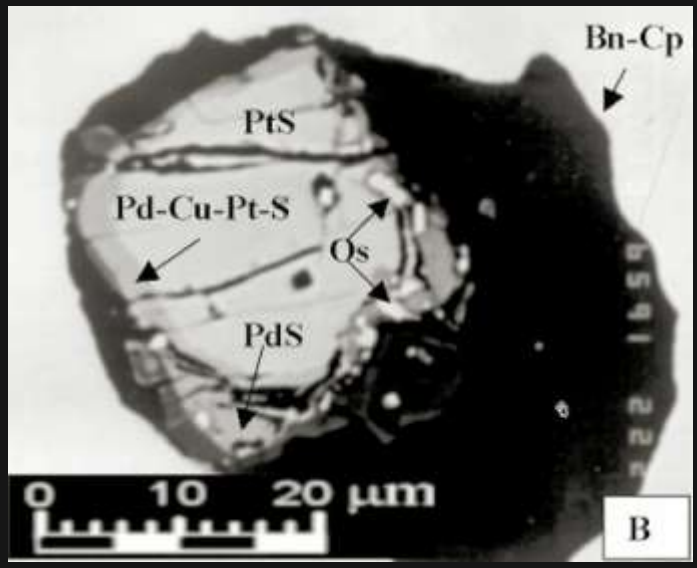
Practice

Osmium is a very dense metal. What is its density in g/cm^3 if 50.00 g of the metal occupies a volume of 2.22cm^3?

1) 2.25 g/cm^3

2) 22.5 g/cm^3

3) 111 g/cm^3



Solution

2) Placing the mass and volume of the osmium metal into the density setup, we obtain

$$D = \frac{\text{mass}}{\text{volume}} \rightarrow \frac{50.00\ g}{2.22\ cm^3} \rightarrow$$

$$\rightarrow 22.522522\ g/cm^3 \rightarrow 22.5\ g/cm^3$$

Home Work
2-Sept-2015

Complete on same sheet as previous book work,

Problem: p43-45

#29, 33, 37, 38, 39

Closure

What is the percent error in the results of the following measurement: Outside air temp was found to be 29.3°C but was actually 30.04°C.

Hint: $\frac{|\text{Actual value} - \text{your value}|}{\text{Actual value}} \times 100\%$

"Density Practice Problems"

Complete ALL Work on a separate sheet of paper. The provided example should be followed. You WILL NOT RECEIVE credit if dimensional analysis is not used ☺

Bellwork
3-Sept-2015

What is the density (g/mL) of a solution with a volume of $3.1E^{-4}$ m^3 and a mass of 340.0g?

Density = m/v

EQ: Suppose there are three parts to learning in school; student, teacher, and content/material. What is your role as a student including responsibilities and expectations

Objective

You will be able to use density as a conversion factor between mass and volume.

You will know how to correctly save, attach, label, and email you density of metals graph.

Density

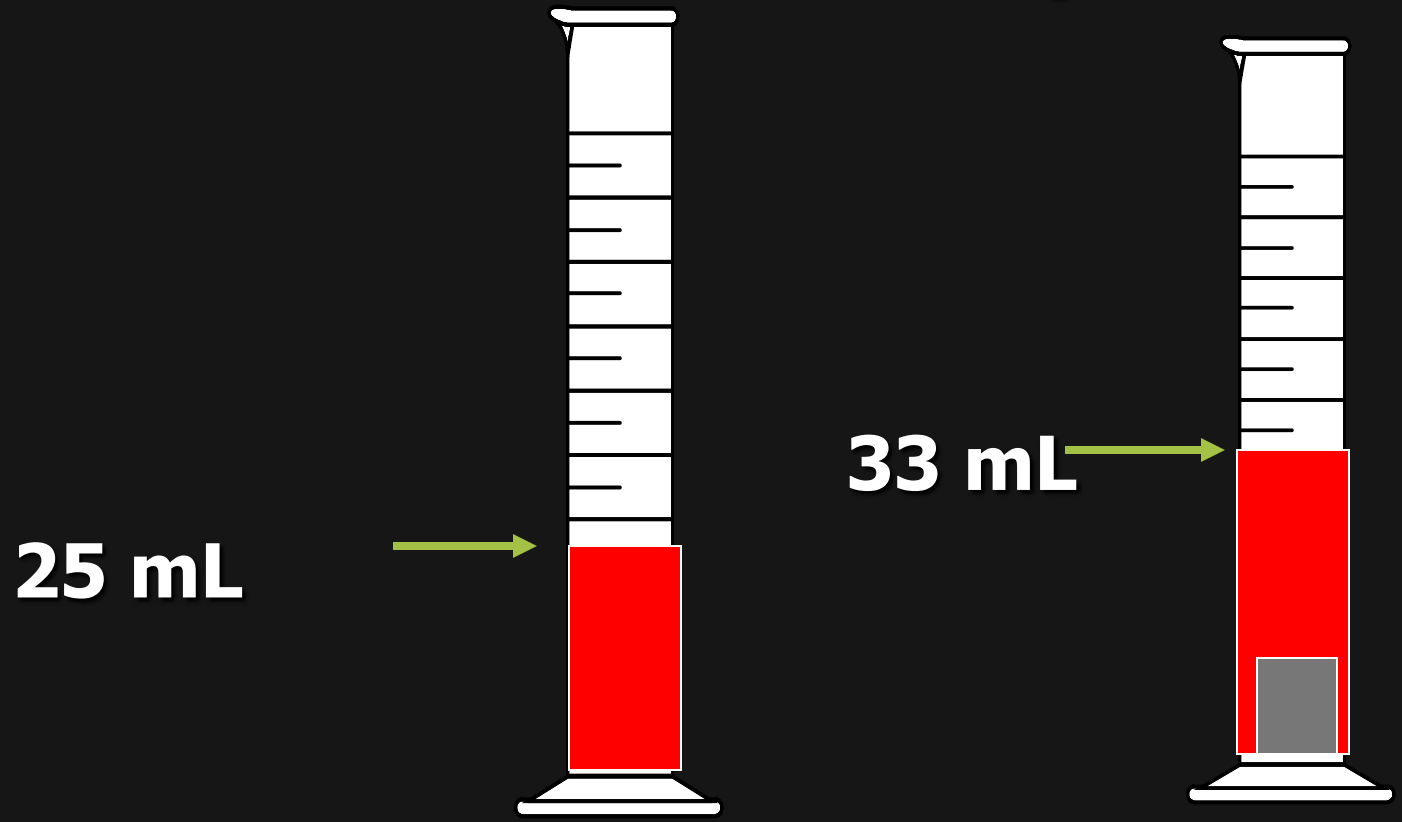
Objective

Students will be able to make an excel graph of their lab data

Students will use excel graph to estimate density

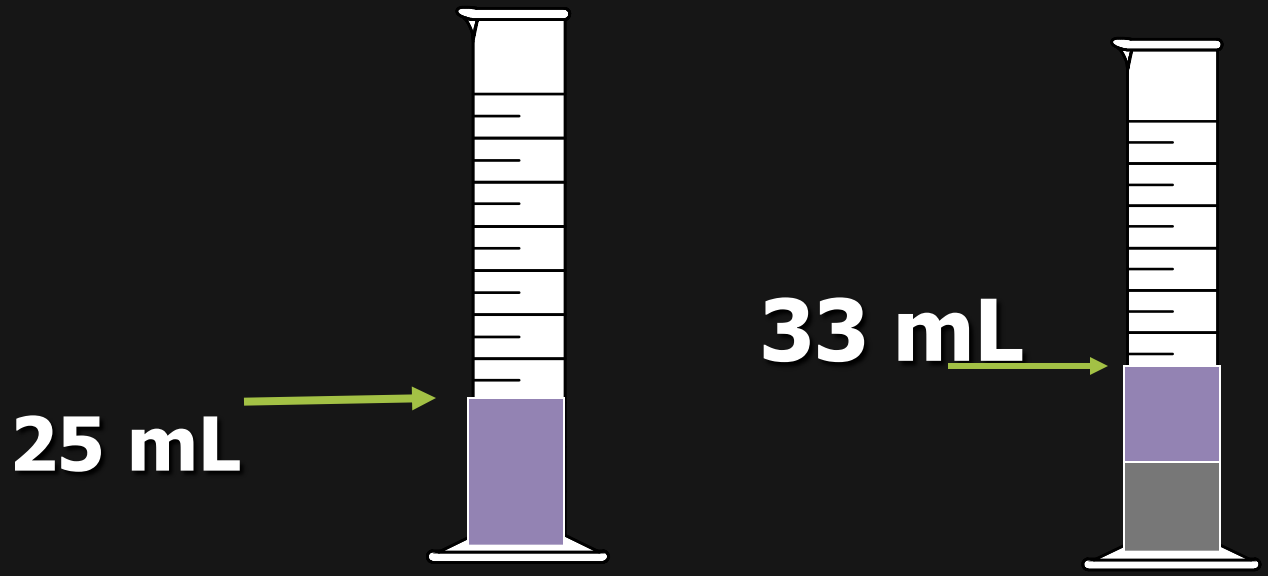
Volume Displacement

A solid displaces a matching volume of water when the solid is placed in water.



Practice

What is the density (g/cm^3) of 48 g of a metal if the metal raises the level of water in a graduated cylinder from 25 mL to 33 mL? A) 0.2 g/ cm^3 B) 6g/cm^3 C)252g/cm^3



Solution

B) 6 g/cm³

Volume (mL) of water displaced

= 33 mL - 25 mL = 8 mL

Volume of metal (cm³)

$$= 8 \text{ mL} \times \frac{1 \text{ cm}^3}{1 \text{ mL}} = 8 \text{ cm}^3$$

Density of metal =

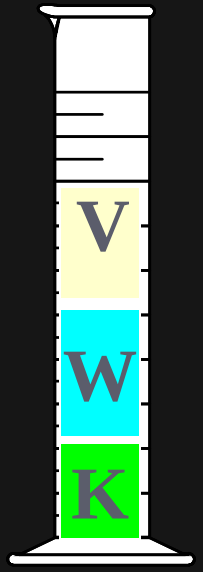
$$\frac{\text{mass}}{\text{volume}} = \frac{48 \text{ g}}{8 \text{ cm}^3} = 6 \text{ g/cm}^3$$

Practice

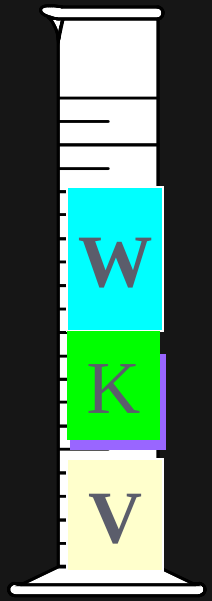
Which diagram represents the liquid layers in the cylinder?

(K) Karo syrup (1.4 g/mL), (V) vegetable oil (0.91 g/mL,) (W) water (1.0 g/mL)

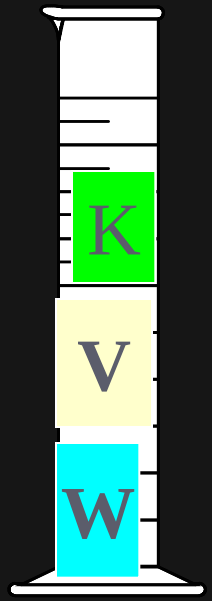
1)



2)

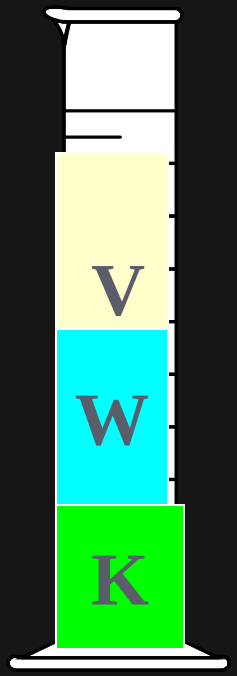


3)



Solution

1)



(V) vegetable oil (0.91 g/mL,)

(W) water (1.0 g/mL)

(K) Karo syrup (1.4 g/mL),

Density as Conversion Factors

A substance has a density of 3.8 g/mL.

Density = 3.8 g/mL

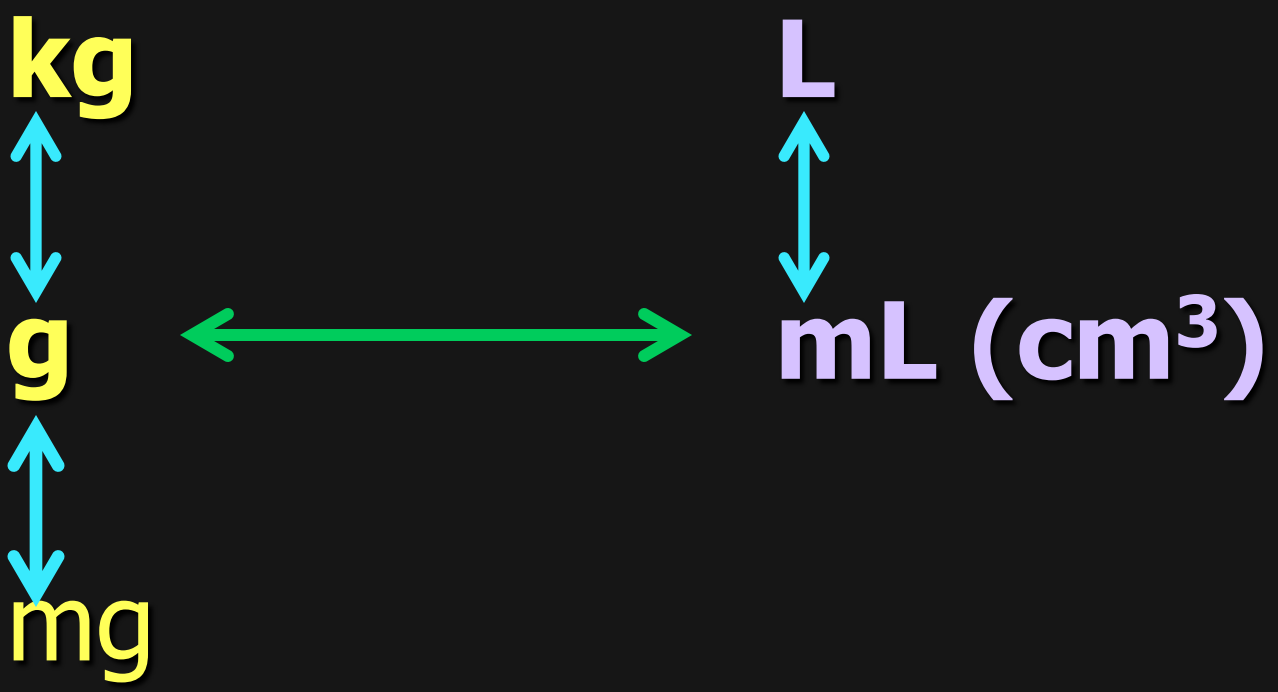
Equality 3.8 g = 1 mL

Conversion factors.

$$\frac{3.8\ \text{g}}{1\ \text{mL}} \quad \text{and} \quad \frac{1\ \text{mL}}{3.8\ \text{g}}$$

Density Connections

Mass **Volume**



Home Work
3-Sept-2015

Problem: p43-45

#51-53, 56, 57

Practice

The density of octane, a component of gasoline, is 0.702 g/mL. What is the mass of 875 mL of octane?

A) 0.614 g

B) 614 g

C) 1.25 g

Solution

B) 614 g

Equalities: 1 mL = 0.702 g

Setup:

$$875\ \text{mL} \times \frac{0.702\ \text{g}}{1\ \text{mL}} = 614\ \text{g}$$

density factor

Practice

I threw a plastic ball in the pool for my dog to fetch. The mass of the ball was 125 grams. What is the volume in L if the ball has a density of 0.500 g/mL?

1) 250L 2) 2.50L 3) 0.250L

Solution

3)

Unit Plan: g → mL → L

$$125\ g \times \frac{1\ mL}{0.500\ g} \times \frac{1\ L}{1000\ mL} = 0.25L$$

Practice

If blood has a density of 1.05 g/mL, how many liters of blood are donated if 575 g of blood are given?

A) 0.548 L

B) 1.25 L

C) 1.83 L

Solution

A)

Unit Plan: g → mL → L

$$575\ \text{g} \times \frac{1\ \text{mL}}{1.05\ \text{g}} \times \frac{1\ \text{L}}{1000\ \text{mL}} = 0.548\ \text{L}$$

Before you leave…

What is the most challenging aspect of solving density problems for me?

Where can I get help with them?

Bell Work
8-Sept-2015
New Bell Work #3

A: If an empty 125mL glass flask weighs 75g and when filled with water weighs 200g, what is the mass of the water?

B: What is the density of the water?

Density

Objective

Apply dimensional analysis to density based problems.

Turn In 8Sept2015

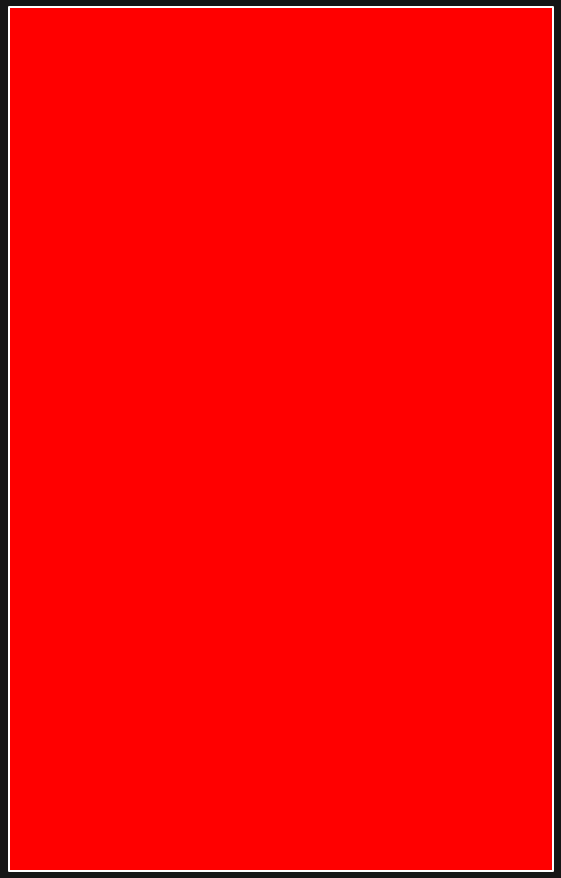
Bell Work #2

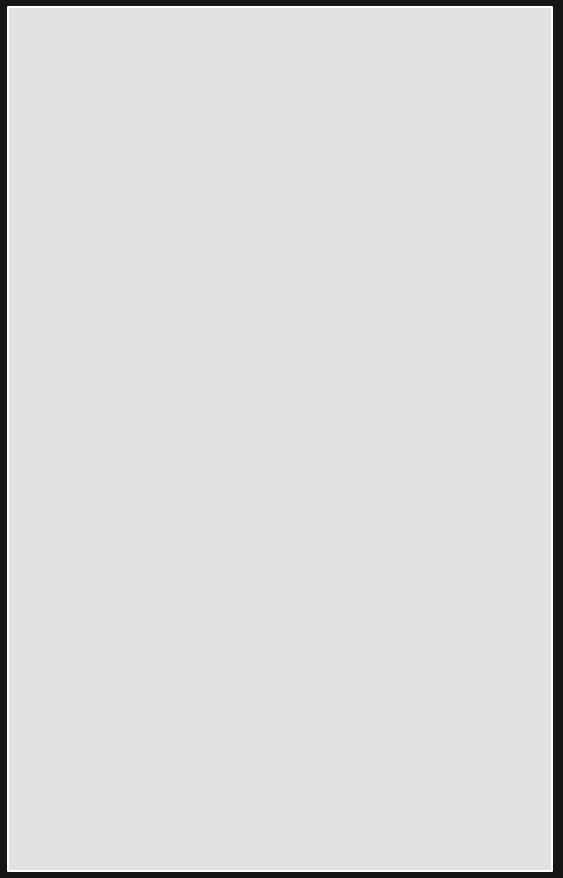
Density Practice Problems

Book Work #29-57, from last week

Why Does it not Float?

Please list 3 or more reasons why Diet Coke floats and Coke sinks





Root Words

hyper- representing over, above

ex. *Hyperactive, hypertonic, hypertension*

intra - within, inside

ex. Intracellular, intraocular, intraspecies

hydr- water

ex. Hydrophilic, hydroscopic, hydrogen

9-Sept-2015

If Al has a density of 2.70 g/cm^3 and a bolt made of Al has a volume of 12.5 mm^3, what would the mass of the bolt be, in grams?

What about box of 1,000 bolts in kg?

EQ: What value does ***my*** education have in ***my*** future?

Concept of Density

Demo~~'s~~

Word Problems

Density Vocabulary

Weight: is a measure of the gravitational force on an object.

Volume is the amount of space an object occupies

Mass is the amount of matter which occupies a given space.

Density, a Visual Explanation

100g popcorn kernels 100g popped popcorn

a. Which bag has a greater volume of popcorn?
The popped kernels have a larger volume than the unpopped kernels.

b. Which type of popcorn is more dense?
The unpopped kernels.

c. Which bag has a greater mass?
Both bags have the same mass.

d. Which bag weighs the most?
Both bags weigh the same.

Density, a Visual Explanation cont.

Using the following three words; density, mass, and volume, describe why the bag of kernels is more dense then the popped bag.

Complete sentences, correct use of words is necessary.

A flask that weighs 200.5g is filled with 125mL of compound X. The weight of the flask and compound X is found to be 410.5g. From this information, calculate the density of compound X.

What is wanted	Plan to solve
What information is provided	Calculation
Useful formulas/ conversions	

Graphing

A student obtained the following data is the lab:

Mass (g)	Vol. (cm^3)
0.5	0.12
4	0.97
1.5	0.36
2.5	0.61
2.75	0.67

Graph the data and plot a best fit line.

What is the slope of the line?

What does that slope tell us?

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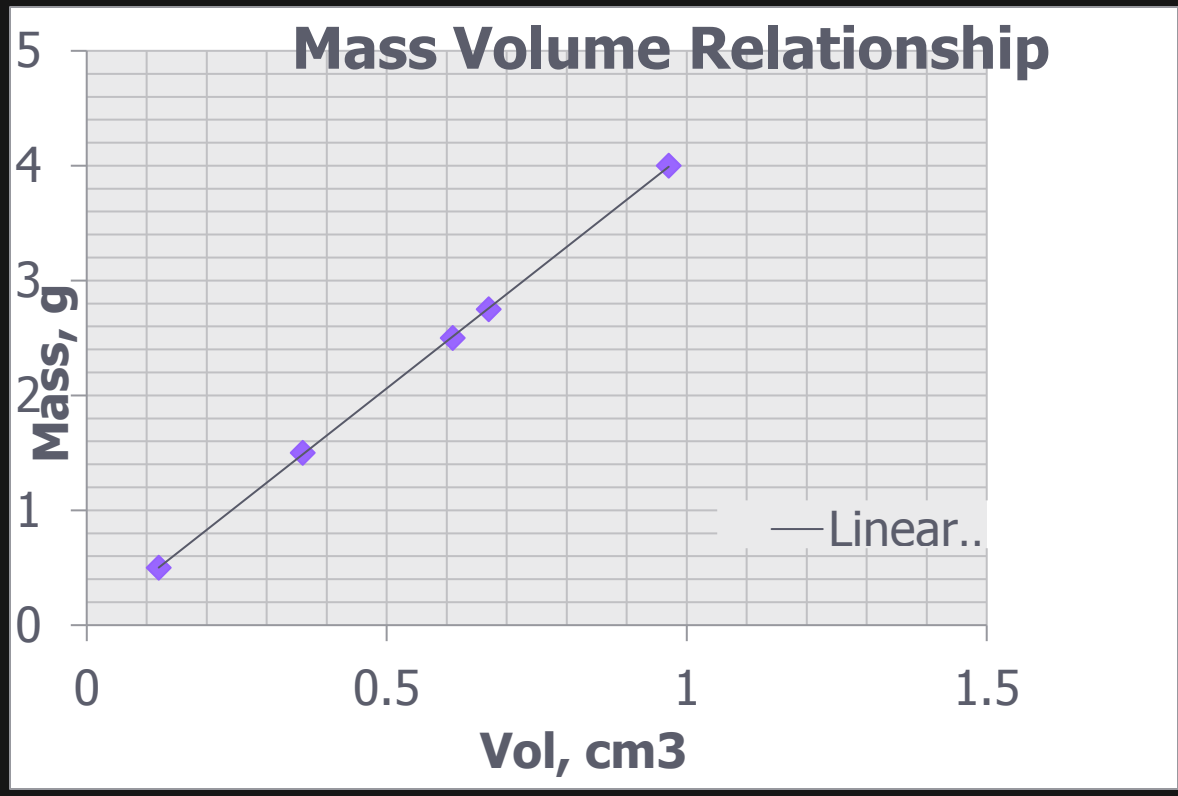

Practice

A cup of gold colored metal beads was measured to have a mass 425 grams. By water displacement, the volume of the beads was calculated to be 48.0 cm^3. Given the following densities, identify the metal.

Gold: 19.3 g/ cm^3

Copper: 8.86 g/ cm^3

Bronze: 9.87 g/ cm^3

Solution

$$\frac{425\text{g}}{48\ \text{cm}^3} = 8.86\text{g/cm}^3$$

Copper

Step by Step

After crossing a bridge in your car you come up to a massive concrete block obstructing your view, if the block has a volume of $15m^3$ and a mass of 4,500 kg. What is its density in g/L?

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$$\frac{4\,500\ \text{kg}}{15\ \text{m}^3} \times \frac{1\ \text{m}^3}{1\,000\ \text{dm}^3} \times \frac{1\ \text{dm}^3}{1\ \text{L}} \times \frac{1\,000\ \text{g}}{1\ \text{kg}}$$

300g/L

Learning Check

A group of students collected 125 empty aluminum cans to take to the recycling center. If 21 cans make 454 grams of aluminum, how many liters of aluminum (D=2.70 g/cm^3) are obtained from the cans?

A)1.0 L B) 2.0 L C) 4.0 L

Solution

A) 1.0 L

$$125 \text{ cans} \times \frac{454 \text{ g}}{21 \text{ cans}} \times \frac{1 \text{ cm}^3}{2.70 \text{ g}} \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{1 \text{ L}}{1000 \text{ mL}} =$$

B======)

1.0 L

Partner Practice

You have 3 metal samples. Which one will displace the greatest volume of water?

1

25 g Al
2.70 g/mL

2

45 g of gold
19.3 g/mL

3

75 g of Lead
11.3 g/mL

Discuss your choice with your partner.

Solution

1) $25\ g\ Al \times \frac{1\ mL}{2.70\ g} = 9.2\ mL$

25 g Al
2.70 g/mL

More Practice

Find the mass of a 50.0 ml quantity of water if the density of water is 1.00 g/ml.

The density of air is 1.3 g/L. How many liters of air weight 2 000 kg.

The density of Ethanoic Acetic Acid is 1.05g/cm^3. What is the mass in kilograms of a volume of 5L?

More Practice

Lithium, a metal found in high end batteries, has a density of 0.53 g/cm^3. Mr. Osakie of Sony bought a shipping crate full of Li from Clayton Valley, USA. It was completely laiden with Li and had dimensions of 1.5m x 2.5m x 3m. What was the mass of the Li in Kg?

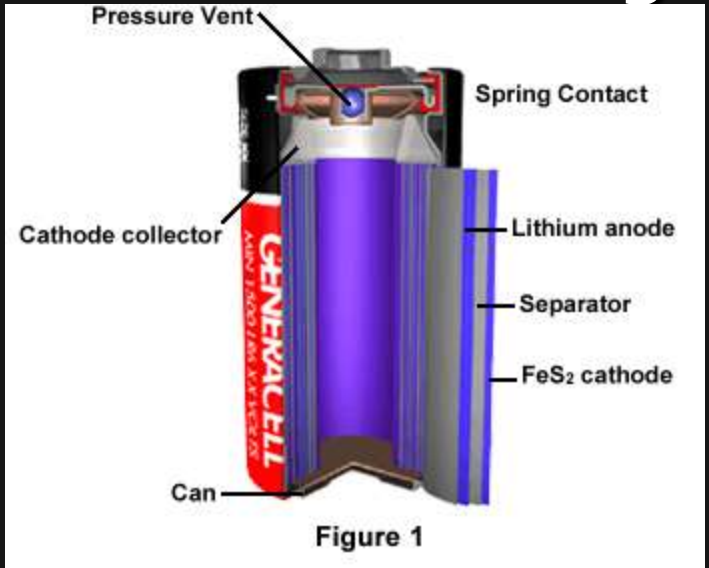

Figure 1

Density and Temperature

On your "Density Lab"

We will look at the movement of a dye through water and different temperatures and try to extrapolate the relationship to density.

Record time it takes dye to move vs. temp to try to draw the relationship between ρ vs. °C

What other concept is demonstrated in the experiment?

Density vs. Temp H_2O Explorations

Purpose: Rationalize and investigate how density and temperature are related.

1. Devise a way to measure the density, mass (g) per volume (mL), of each of the samples of water.
2. Record measurements in a data table ***you*** design.

Density Column

We will add the following liquids to a graduated cylinder to see how they separate themselves out:

Fuel
Cooking oil
Water
Soap
Corn Syrup
Honey

Air and Mass

Given the following how could you find the density of air?

Balloon
Tub of water
0.00g scale
1 000mL graduated cylinder

Study Tips

Small groups,

Go through notes and…

- Identify topics/ themes from HW & Lectures
- Repeated practice questions
- Lab concepts/ topics and post lab questions

Test Taking Tips

Eat Breakfast!

Relax

Read over the entire test

- Identify problems you know how to do
- Identify problems that may take extra time.